Amendments To The Claims

This listing of claims will replace all prior versions, and listings, of claims in the application:

Listing of Claims:

1. (Currently amended) A method for analyzing an image, comprising:

constructing a graph to represent an object appearing in the image,

wherein the object has a shape, and the graph comprises vertices connected by edges and arranged in a spatial relation responsive to the shape;

~~generating~~ mapping the graph to a string ~~of symbols corresponding to the graph~~ by traversing the edges of the graph and for each edge traversed,

adding to the string a character from a four-letter alphabet in which each character is indicative of a predefined feature of the spatial relation between the vertices connected by the edge; and

processing the string so as to classify the object.

2. (Currently amended) A method according to claim 1, wherein ~~generating the string~~ mapping the graph comprises

generating first and second strings to represent first and second graphs, respectively, so that the first and second strings are identical if and only if the first and second graphs are isomorphic.

3. (Original) A method according to claim 2, wherein the graphs comprise vertices, and wherein constructing the graph comprises constructing the first and second graphs so that the vertices of each of the graphs are arranged in a specified spatial relation, and wherein generating the first and second strings comprises constructing the strings so as to reflect the spatial relation of the vertices.

4. (Original) A method according to claim 3, wherein constructing the graph comprises assigning the vertices to represent respective portions of a contour of a shape of the object in the image, and arranging the vertices in the specified spatial relation responsive to relative positions in the image of the respective portions of the contour.

5. (Original) A method according to claim 4, wherein assigning the vertices comprises positioning Cartesian coordinate axes relative to the contour and determining the relative positions of the portions of the contour with respect

to the axes, and wherein arranging the vertices comprises positioning the vertices so as to preserve up/down and left/right relations of the positions of the portions of the contour.

6. (Original) A method according to claim 1, wherein constructing the graph comprises dividing a contour of a shape of the object in the image into multiple portions, and assigning vertices of the graph respectively to represent the portions of the contour.

7. (Original) A method according to claim 6, wherein dividing the contour comprises positioning Cartesian coordinate axes relative to the contour at a plurality of different orientation angles, and finding the portions of the contour at each of the angles, and

wherein constructing the graph comprises constructing a plurality of respective graphs in which the vertices represent the portions of the contour at the different orientation angles, and

wherein generating and processing the string comprise generating and processing a plurality of strings corresponding to the respective graphs so as to classify the shape.

8. (Original) A method according to claim 6, wherein constructing the graph comprises constructing a sequence of graphs that correspond to successively simplified versions of the contour and accordingly comprise successively decreasing numbers of the vertices, and

wherein generating and processing the string comprise generating and processing a plurality of strings corresponding to the graphs in the sequence so as to classify the shape.

9. (Currently amended) A method ~~according to claim 8,~~ for analyzing an image, comprising:

constructing a graph to represent an object appearing in the image;

generating a string of symbols corresponding to the graph; and

processing the string so as to classify the object,

wherein constructing the graph comprises dividing a contour of a shape of the object in the image into multiple portions, and assigning vertices of the graph respectively to represent the portions of the contour,

wherein constructing the graph comprises constructing a sequence of graphs that correspond to successively simplified versions of the contour and

accordingly comprise successively decreasing numbers of the vertices,

wherein generating and processing the string comprise generating and processing a plurality of strings corresponding to the graphs in the sequence so as to classify the shape, and

wherein processing the plurality of the strings comprises arranging the strings as elements of a first vector, indexed according to the numbers of the vertices in the corresponding graphs, and computing a measure of distance between the first vector and a second vector, representing a reference contour and indexed in like manner to the first vector, so as to determine a similarity of the shape to the reference contour.

10. (Currently amended) A method according to claim 1, ~~wherein the graph comprises vertices, and~~ wherein ~~generating the string of symbols~~ mapping the graph comprises

performing a depth-first search over the vertices of the graph, and adding one or more symbols to the string for each edge encountered in the search.

11. (Original) A method according to claim 1, wherein processing the string comprises comparing the string

to a reference string representing a reference object so as to assess a similarity of the object to the reference object.

12. (Original) A method according to claim 11, wherein comparing the string comprises computing a string distance between the string and the reference string, so as to calculate a measure of shape difference between the object and the reference object.

13. (Currently amended) Apparatus for analyzing an image, comprising

an image processor, arranged to construct a graph to represent an object appearing in the image,

wherein the object has a shape, and the graph comprises vertices connected by edges and arranged in a spatial relation responsive to the shape, to ~~generate~~ map the graph to a string ~~of symbols corresponding to the graph~~ by traversing the edges of the graph and for each edge traversed, adding to the string a character from a four-letter alphabet in which each character is indicative of a predefined feature of the spatial relation between the vertices connected by the edge, and to process the string so as to classify the object.

14. (Original) Apparatus according to claim 13, wherein the processor is arranged to generate first and second strings to represent first and second graphs, respectively, so

that the first and second strings are identical if and only if the first and second graphs are isomorphic.

15. (Original) Apparatus according to claim 14, wherein the graphs comprise vertices, and wherein the processor is arranged to construct the first and second graphs so that the vertices of each of the graphs are arranged in a specified spatial relation, and to generate the first and second strings so as to reflect the spatial relation of the vertices.

16. (Original) Apparatus according to claim 15, wherein the processor is adapted to assign the vertices to represent respective portions of a contour of a shape of the object in the image, and to arrange the vertices in the specified spatial relation responsive to relative positions in the image of the respective portions of the contour.

17. (Original) Apparatus according to claim 16, wherein the processor is arranged to position Cartesian coordinate axes relative to the contour and to determine the relative positions of the portions of the contour with respect to the axes, and to position the vertices so as to preserve up/down and left/right relations of the positions of the portions of the contour.

18. (Original) Apparatus according to claim 13, wherein the processor is arranged to divide a contour of a shape of the object in the image into multiple portions, and to assign vertices of the graph respectively to represent the portions of the contour.

19. (Original) Apparatus according to claim 18, wherein the processor is arranged to position Cartesian coordinate axes relative to the contour at a plurality of different orientation angles and to find the portions of the contour at each of the angles, and is further arranged to construct a plurality of respective graphs in which the vertices represent the portions of the contour at the different orientation angles, so as to generate and process a plurality of strings corresponding to the respective graphs for use in classifying the shape.

20. (Original) Apparatus according to claim 18, wherein the processor is arranged to construct a sequence of graphs that correspond to successively simplified versions of the contour and accordingly comprise successively decreasing numbers of the vertices, and to generate and process a plurality of strings corresponding to the graphs in the sequence for use in classifying the shape.

21. (Currently amended) Apparatus ~~according to claim 20,~~ for analyzing an image, comprising an image processor, arranged to construct a graph to represent an object appearing in the image, to generate a string of symbols corresponding to the graph, and to process the string so as to classify the object,

wherein the processor is arranged to divide a contour of a shape of the object in the image into multiple portions, and to assign vertices of the graph respectively to represent the portions of the contour,

wherein the processor is arranged to construct a sequence of graphs that correspond to successively simplified versions of the contour and accordingly comprise successively decreasing numbers of the vertices, and to generate and process a plurality of strings corresponding to the graphs in the sequence for use in classifying the shape, and

wherein the processor is adapted to arrange the strings as elements of a first vector, indexed according to the numbers of the vertices in the corresponding graphs, and to compute a measure of distance between the first vector and a second vector, representing a reference contour and indexed in like manner to the first vector, so as to determine a similarity of the shape to the reference contour.

22. (Currently amended) Apparatus according to claim 13, ~~wherein the graph comprises vertices, and~~ wherein the processor is arranged to generate the string of symbols by performing a depth-first search over the vertices of the graph, and adding one or more symbols to the string for each edge encountered in the search.

23. (Original) Apparatus according to claim 13, wherein the processor is arranged to compare the string to a reference string representing a reference object so as to assess a similarity of the object to the reference object.

24. (Original) Apparatus according to claim 23, wherein the processor is arranged to compare the string by computing a string distance between the string and the reference string, so as to calculate a measure of shape difference between the object and the reference object.

25. (Currently amended) A computer software product, comprising a computer-readable medium in which program instructions are stored, which instructions, when read by a computer, cause the computer to construct a graph to represent an object appearing in an image,

wherein the object has a shape, and the graph comprises vertices connected by edges and arranged in a

spatial relation responsive to the shape, to ~~generate~~ map the graph to a string ~~of symbols corresponding to the graph~~ by traversing the edges of the graph and for each edge traversed, adding to the string a character from a four-letter alphabet in which each character is indicative of a predefined feature of the spatial relation between the vertices connected by the edge, and to process the string so as to classify the object.

26. (Original) A product according to claim 25, wherein the instructions cause the computer to generate first and second strings to represent first and second graphs, respectively, so that the first and second strings are identical if and only if the first and second graphs are isomorphic.

27. (Original) A product according to claim 26, wherein the graphs comprise vertices, and wherein the instructions cause the computer to construct the first and second graphs so that the vertices of each of the graphs are arranged in a specified spatial relation, and to generate the first and second strings so as to reflect the spatial relation of the vertices.

28. (Original) A product according to claim 27, wherein the instructions cause the computer to assign the

vertices to represent respective portions of a contour of a shape of the object in the image, and to arrange the vertices in the specified spatial relation responsive to relative positions in the image of the respective portions of the contour.

29. (Original) A product according to claim 28, wherein the instructions cause the computer to position Cartesian coordinate axes relative to the contour and to determine the relative positions of the portions of the contour with respect to the axes, and to position the vertices so as to preserve up/down and left/right relations of the positions of the portions of the contour.

30. (Original) A product according to claim 25, wherein the instructions cause the computer to divide a contour of a shape of the object in the image into multiple portions, and to assign vertices of the graph respectively to represent the portions of the contour.

31. (Original) A product according to claim 30, wherein the instructions cause the computer to position Cartesian coordinate axes relative to the contour at a plurality of different orientation angles and to find the portions of the contour at each of the angles, and further

cause the computer to construct a plurality of respective graphs in which the vertices represent the portions of the contour at the different orientation angles, so as to generate and process a plurality of strings corresponding to the respective graphs for use in classifying the shape.

32. (Original) A product according to claim 30, wherein the instructions cause the computer to construct a sequence of graphs that correspond to successively simplified versions of the contour and accordingly comprise successively decreasing numbers of the vertices, and to generate and process a plurality of strings corresponding to the graphs in the sequence for use in classifying the shape.

33. (Currently amended) A computer software ~~product according to claim 32~~, comprising

a computer-readable medium in which program instructions are stored, which instructions, when read by a computer, cause the computer to construct a graph to represent an object appearing in an image, to generate a string of symbols corresponding to the graph, and to process the string so as to classify the object,

wherein the instructions cause the computer to divide a contour of a shape of the object in the image into

multiple portions, and to assign vertices of the graph respectively to represent the portions of the contour,

wherein the instructions cause the computer to construct a sequence of graphs that correspond to successively simplified versions of the contour and accordingly comprise successively decreasing numbers of the vertices, and to generate and process a plurality of strings corresponding to the graphs in the sequence for use in classifying the shape, and

wherein the instructions cause the computer to arrange the strings as elements of a first vector, indexed according to the numbers of the vertices in the corresponding graphs, and to compute a measure of distance between the first vector and a second vector, representing a reference contour and indexed in like manner to the first vector, so as to determine a similarity of the shape to the reference contour.

34. (Currently amended) A product according to claim 25, ~~wherein the graph comprises vertices, and~~

wherein the instructions cause the computer to generate the string of symbols by performing a depth-first search over the vertices of the graph, and adding one or more symbols to the string for each edge encountered in the search.

35. (Original) A product according to claim 25, wherein the instructions cause the computer to compare the string to a reference string representing a reference object so as to assess a similarity of the object to the reference object.

36. (Original) A product according to claim 35, wherein the instructions cause the computer to compare the string by computing a string distance between the string and the reference string, so as to calculate a measure of shape difference between the object and the reference object.